AABC Commissioning Group

AIA Provider Number 50111116

Existing Building Commissioning in Health Care Facilities

Course Number: CXENERGY1710

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ENERActive Solutions,
an Edison Energy$_{SM}$ Company

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Course Description

Drawing on technical examples, lessons learned, and best practices from a recent award winning healthcare facility project, this presentation comprehensively explores the key components necessary to execute successful existing building commissioning (EBCx) projects in mission critical buildings.

Learning Objectives

At the end of the this course, participants will be able to:

1. Understand the Existing Building Commissioning (EBCx) Process.

2. Understand financial and operational benefits of the Existing Building Commissioning (EBCx) Process.

3. Understand the benefits of utilizing incentive funding.

4. Determine the expected results of implementing the Existing Building Commissioning for their facilities.

"The **biggest** gains, in terms of decreasing the country's energy bill, the amount of carbon dioxide we put into the atmosphere, our dependency on foreign oil, will come from **energy efficiency** and **conservation** in the next 20 years."

Steven Chu
Former Secretary – Dept. of Energy

Existing Building Cx

- Systematic process
- Investigating, analyzing & optimizing
- Identification & implementation of low/no cost ECM’s
- Ensuring continued performance

Benefits of EBCx

- Excellent ROI (return on investment)
- Reduces energy costs/ budget
- Verifies/ validates environmental criteria
- Reduced maintenance
- Increased system reliability
- Improved occupant comfort
- Solve long term operating problems

How does this differ from EA?

- Hands-On Approach to Retro-Cx; Construction, Components & Capacity
  - Design / Installation Reviews
  - Functional Checks
  - Performance Tests

Typical Test Equipment Used

TSI (anemometer): temperature/humidity checks & airflow traverses

Tachometer for testing speed

DP Calc for static pressure checks

Balometer for testing airflows at diffusers

Power meter for power readings

Vane Anemometer for testing face velocities (over coils/ dampers/ fume hoods, etc)

Alnor DP meter for testing fluid flows at coils

Process Milestones

- Site orientation & documentation review
- Define the Current Facility Requirements (CFR)
- Energy Analysis / Benchmarking
- Trending/ Data logging
- Design/ Installation reviews (DIRs)
- Functional checks (FCs)
- Performance tests (PTs)
- Reporting & Issue Resolution
- Persistence Strategy

EBCx in Healthcare

- Stringent patient requirements
  - Facility's staff must often place patients' needs, comfort and safety above energy consumption
- Complex energy and HVAC systems
  - The intricacies in performance required for the demands of waiting areas, doctors' offices, and operating rooms require a delicate system balance
- Critical nature of the services provided and patients served
  - ECMs need to be easy to implement & sustain
  - Focus on energy without impacting patients' quality of stay and comfort

Sidney Kimmel Center for Prostate & Urologic Cancers

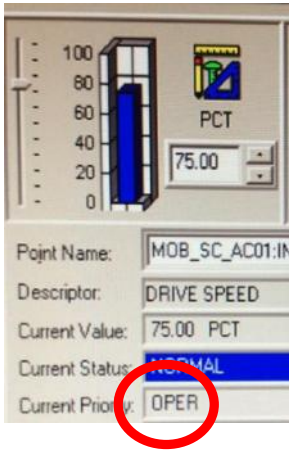
- Project Development & Background
  - Campus-wide Benchmarking Pilot
  - Energy Audit & Retro-Cx Study
  - Focused Engineering Analysis
  - Implementation
  - M&V

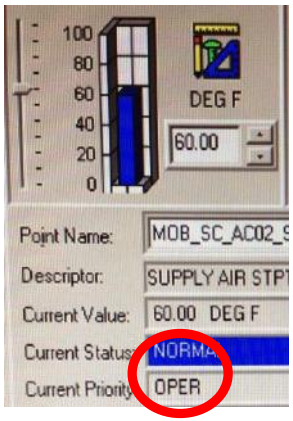
Building HVAC Systems

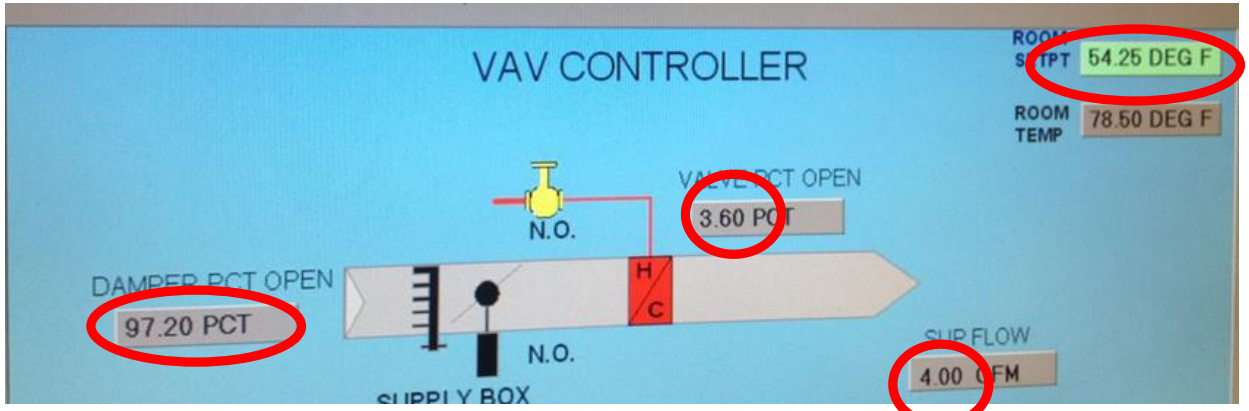
- Air Distribution Systems
  - Five (5) Main Air Handling Units (AHUs)
    - Variable Air Volume (VFDs on SF and RF)
    - DX Cooling
- AHU Controls
  - 24/7 Operation
  - Supply Air Temp Reset 55F – 65F
  - Waterside Economizer & Airside Economizer
- VAV Terminals
  - Constant Volume and Variable Air Volume operation
  - Hot water reheat coils
  - Nighttime setback

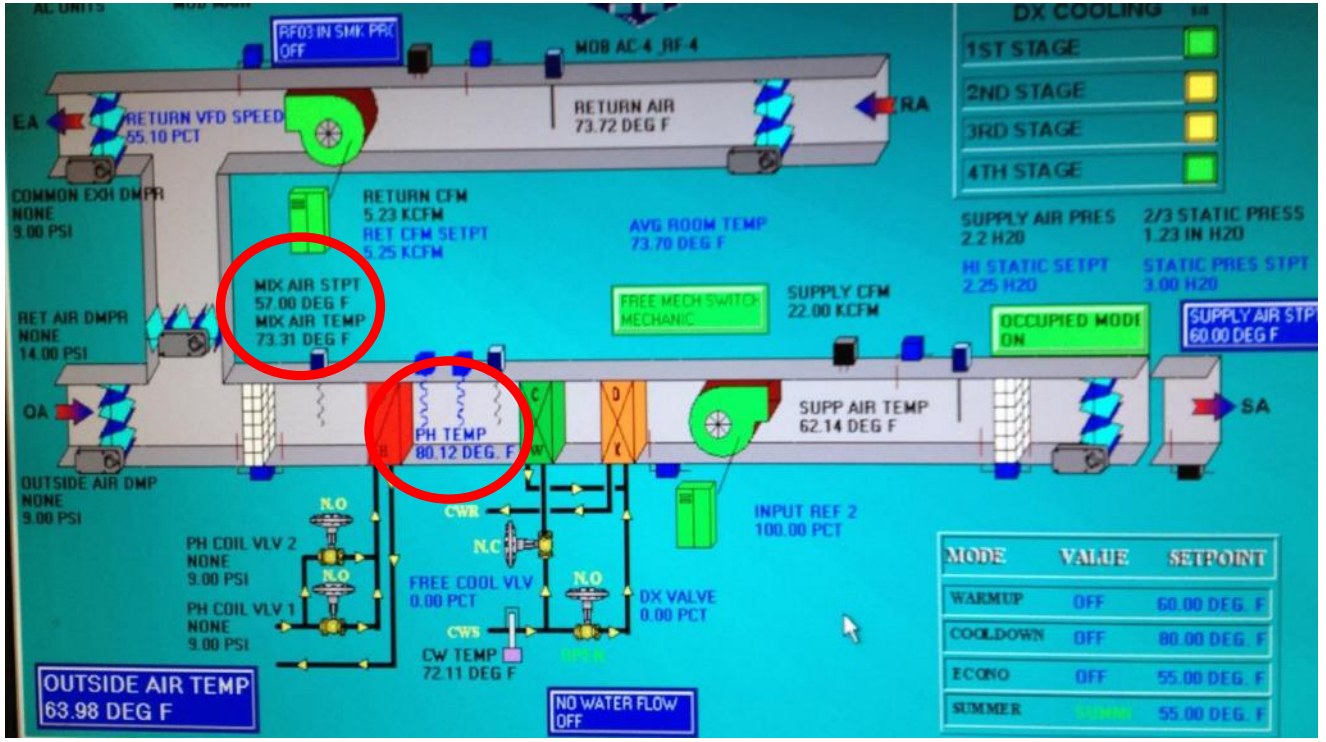
MSKCC Process

- EBCx Process
  - BMS Review
  - Trending Review
  - Design & Installation Review
  - Functional & Performance Testing
  - ECM Development
- Implementation & Remediation
- M&V


100
80
60
40
20
0
PCT
75.00
Point Name:
MOB_SC_AC01:IN
Descriptor:
DRIVE SPEED
Current Value:
75.00 PCT
Current Status:
NORMAL
Current Priority:
OPER

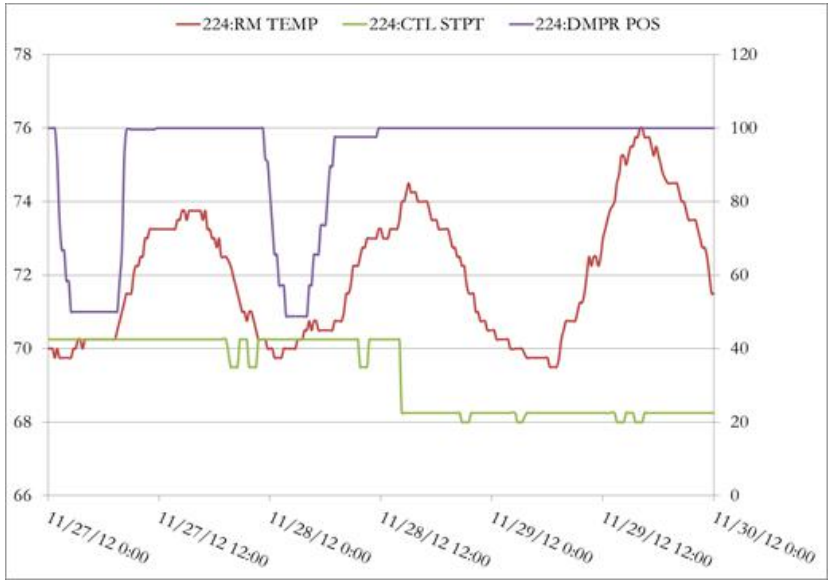

100
80
60
40
20
0
DEG F
60.00
Point Name:
MOB_SC_AC02_S
Descriptor:
SUPPLY AIR STPT
Current Value:
60.00 DEG F
Current Status:
NORMAL
Current Priority:
OPER

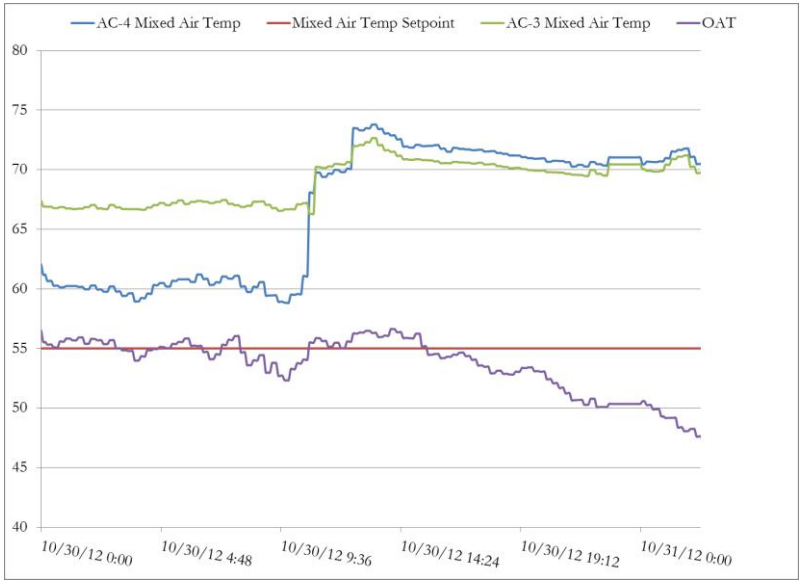

VAV CONTROLLER
ROOM STPT
54.25 DEG F
ROOM TEMP
78.50 DEG F
VALVE PCT OPEN
3.60 PCT
N.O.
DAMPER PCT OPEN
97.20 PCT
H
C
N.O.
SUPPLY BOX
SUP FLOW
4.00 CFM

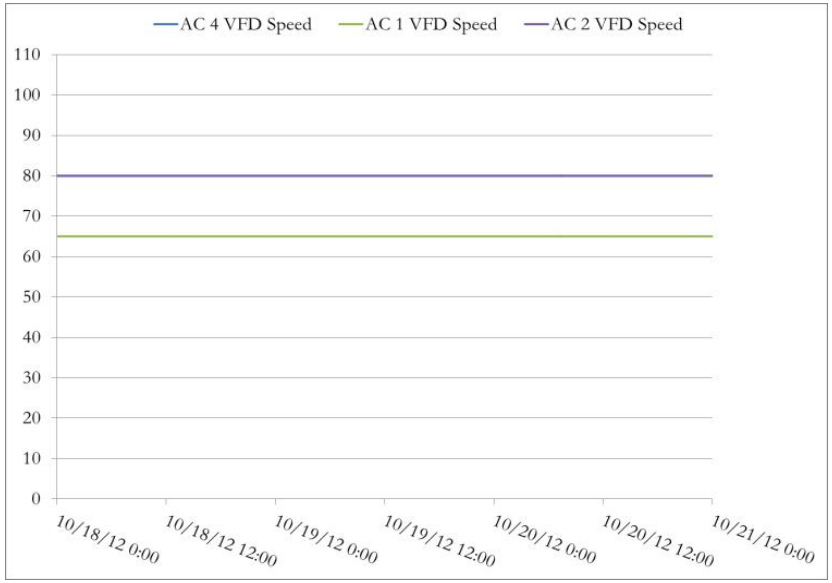

MOB AC 4 RF 4
DX COOLING
1ST STAGE
2ND STAGE
3RD STAGE
4TH STAGE
EA
RETURN VFD SPEED
55.10 PCT
RETURN AIR
73.72 DEG F
RA
COMMON EXH DMPR
NONE
9.00 PSI
RETURN CFM
5.23 KCFM
RET CFM SETPT
5.25 KCFM
AVG ROOM TEMP
73.70 DEG F
SUPPLY AIR PRES
2.2 H20
2/3 STATIC PRESS
1.23 IN H20
HI STATIC SETPT
2.25 H20
STATIC PRES STPT
3.00 H20
MIX AIR STPT
57.00 DEG F
MIX AIR TEMP
73.31 DEG F
FREE MECH SWITCH
MECHANIC
SUPPLY CFM
22.00 KCFM
OCCUPIED MODE
ON
SUPPLY AIR STPT
60.00 DEG F
RET AIR DMPR
NONE
14.00 PSI
OA
PH TEMP
80.12 DEG. F
SUPP AIR TEMP
62.14 DEG F
SA
OUTSIDE AIR DMP
NONE
9.00 PSI
INPUT REF 2
100.00 PCT
PH COIL VLV 2
NONE
9.00 PSI
PH COIL VLV 1
NONE
9.00 PSI
CWR
CWS
FREE COOL VLV
0.00 PCT
DX VALVE
0.00 PCT
CW TEMP
72.11 DEG F
MODE
VALUE
SETPOINT
WARMUP
OFF
60.00 DEG. F
COOLDOWN
OFF
80.00 DEG. F
ECONO
OFF
55.00 DEG. F
SUMMER
55.00 DEG. F
OUTSIDE AIR TEMP
63.98 DEG F
NO WATER FLOW
OFF

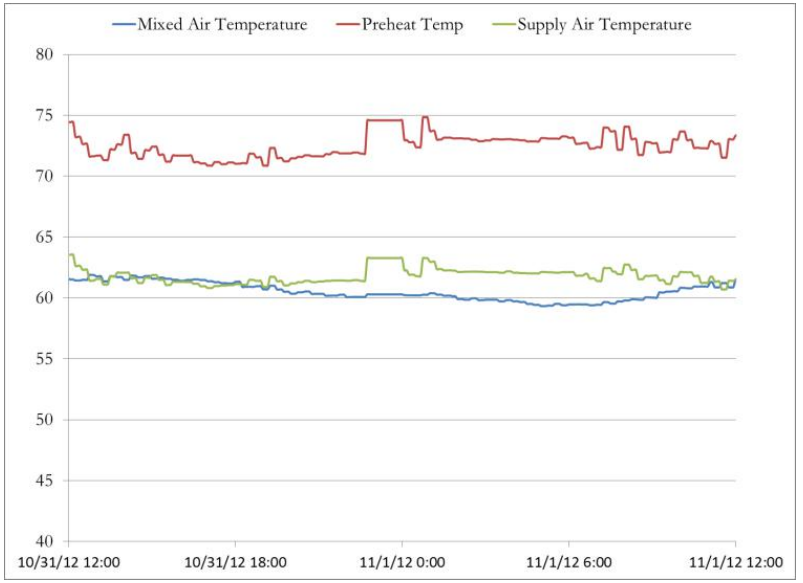
BMS Review

Trend Analysis



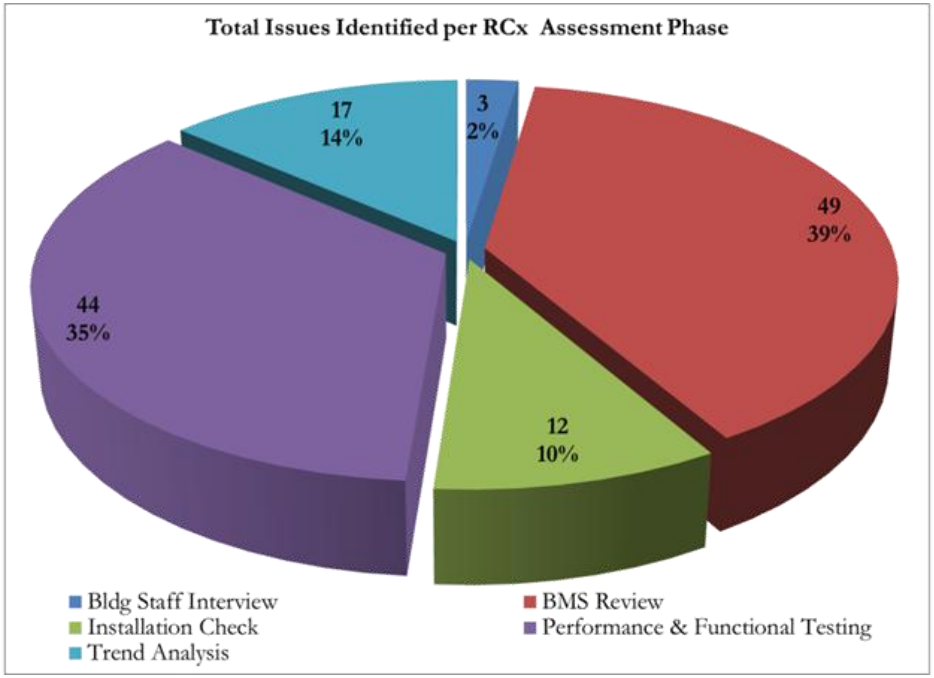






Design & Installation Review

Functional & Performance Tests

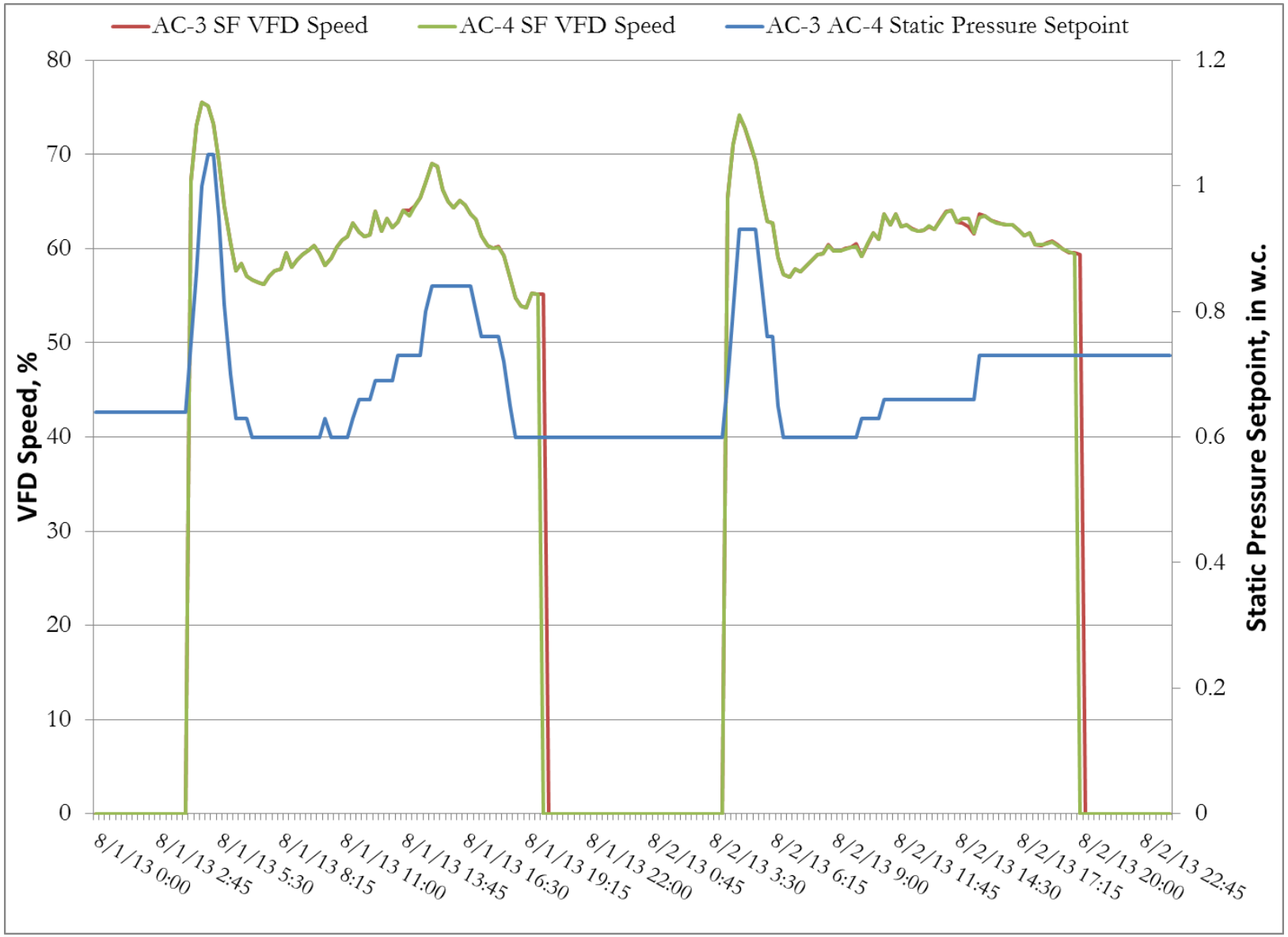


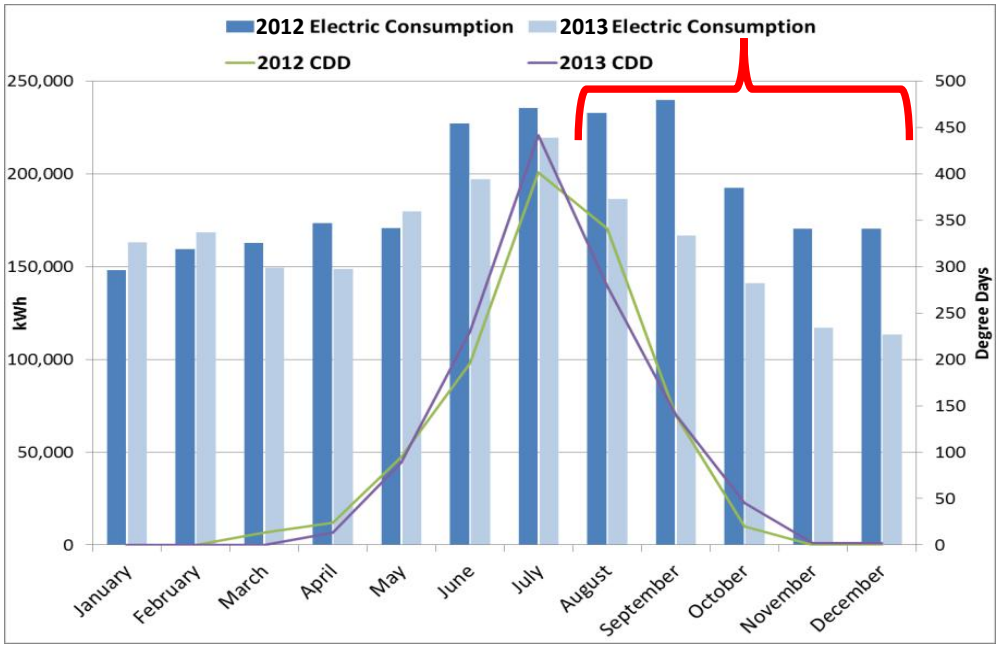
- Determine if:
  - Current condition performing to design values
  - Current SOP fully executed
    - do valves, actuators, VFDs respond as intended?

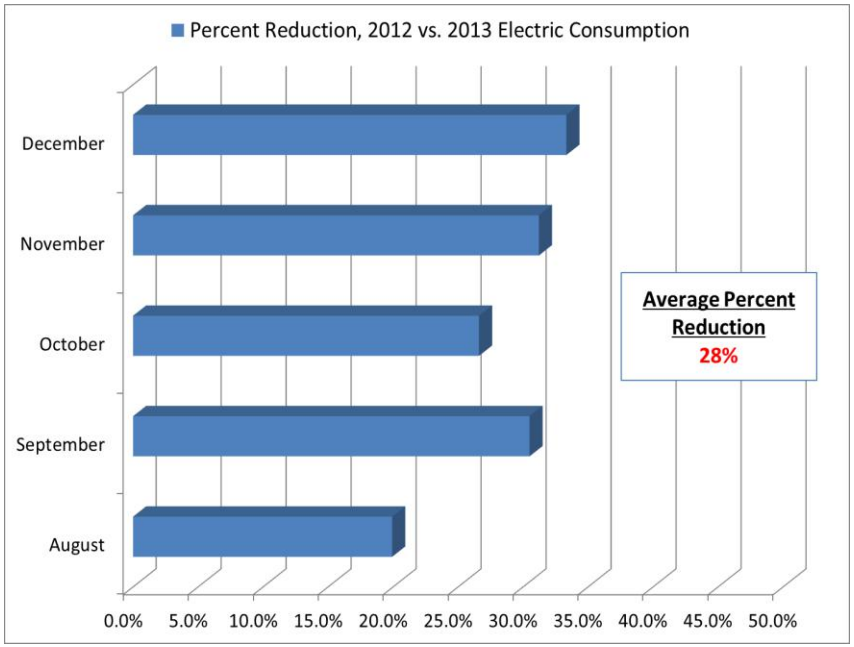
ECM #	Class	ECM Description	Engineering & Modifications	ECM Status	Fuel Type Saved	Energy Saved (kWh)	Energy Saved (kW)	Steam Savings (Klbs)	Annual Dollars Saved	Total Cost	Simple Payback Period
Recommended Capital ECMs											
1	HVAC Schedule	Nighttime & Weekend Shutdown/Setback	Change BMS Operating Schedule and Utilize Optimal Start	R	Electric, Steam	821,785		983	$111,050	$ 32,576	0.3
2	AHU Control	Implement Static Pressure Reset	Program AHU VFD reset schedule based on VAV box damper positions; Verify and Revise VAV SOP	R	Electric, Steam	296,180		157	$ 47,201	$ 100,520	2.1
3A	Primary CW Control & AHU Control	Waterside Economizer Optimization	Implement Primary CW Supply Oat WB Reset and Enable Hybrid/Free Cooling in Winter Mode on AC-1, AC-2, AC-5	R	Electric	49,994			$ 8,499	$ 26,617	1.9
3B		Enable Hybrid and Free Cooling on AC-2	Install Actuators on Econo Coil Valve and Bypass Valve	R	Electric	30,833			$ 5,242		
4	HVAC Retrofit	SF-1 VFD Installation	Install VFD on SF-1 to Reduce Fan Motor Power	R	Electric	56,831	4		$ 6,724	$ 20,560	3.1
5	AHU Control	AC-3, AC-4 Economizer Mode Optimization	Optimize Airside Economizer Cycle	R	Electric	33,577			$ 5,708	$ 23,260	4.1
6	Radiation Heating Scheduling	Implement Radiation Heating Schedule	Enable pump and HX based on OAT and utilize HWS OAT Reset	R	Electric, Steam	904		158	$ 7,189	$ 2,169	0.3
7	AHU Control	Eliminate AC-2, AC-5 Simultaneous Heating & Cooling	Verify AC-2, AC-5 Preheat Valve SOP to Ensure Operation to Meet SAT Setpoint	R	Electric, Steam	9,740		155	$ 8,599	$ 2,169	0.3
Recommended O&M ECMs											
8	AHU Maintenance	Condenser Tube Bundle Cleaning	Clean CW Tube Bundles to Increase Mechanical Cooling Efficiency	R	Electric	11,206			$ 1,905		
9	AHU Maintenance	Eliminate Economizer Coil Leak-By	Calibrate Valve/Actuator on AC-1, AC-5 to Eliminate Leak By	R	Steam						
10	AHU Maintenance	AHU Door Gasket Sealing	Seal Airflow Leaks on AC-1, 2, 3, 4	R	Elect						

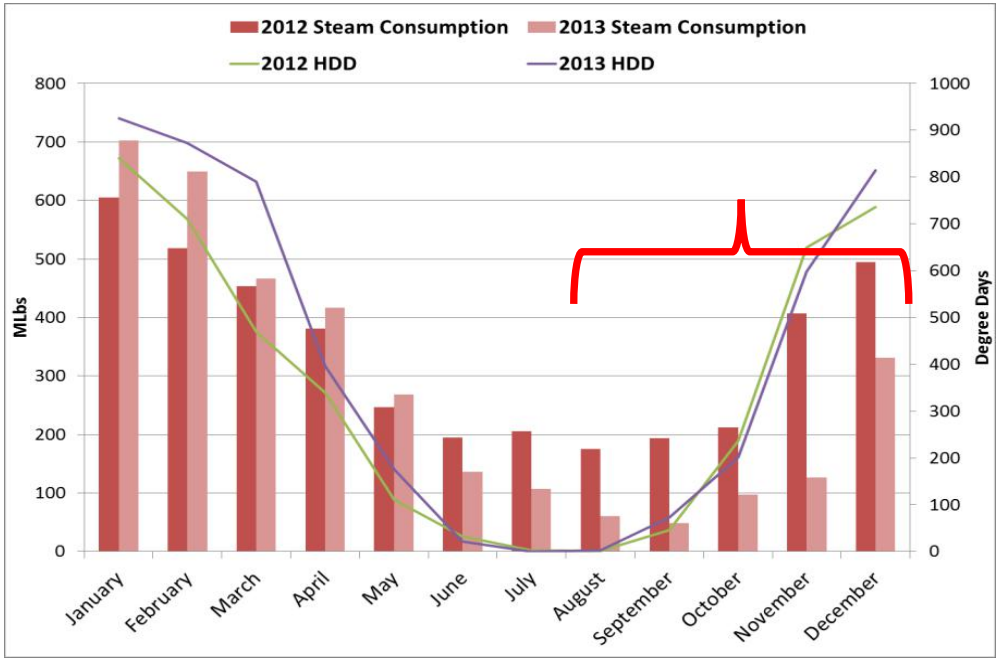
Project Implementation

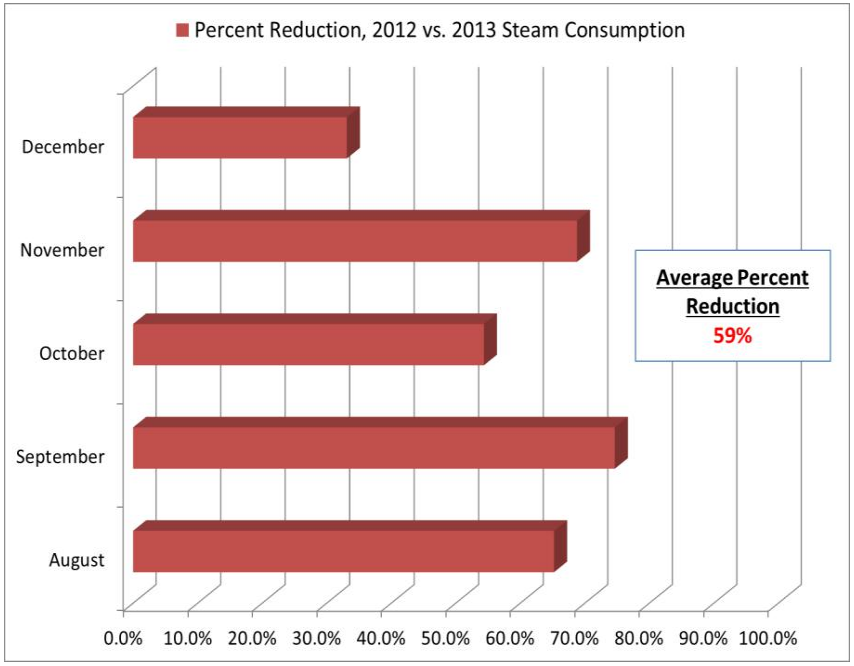
- NYSERDA Energy Adviser Program
  - Heat Load Analysis
  - VAV Remediation
  - Static Pressure Reset Implementation
  - HVAC Scheduling
  - Rebalancing


AC-3 SF VFD Speed
AC-4 SF VFD Speed
AC-3 AC-4 Static Pressure Setpoint
VFD Speed, %
Static Pressure Setpoint, in w.c.
80
70
60
50
40
30
20
10
0
1.2
1
0.8
0.6
0.4
0.2
0
8/1/13 0:00
8/1/13 2:45
8/1/13 5:30
8/1/13 8:15
8/1/13 11:00
8/1/13 13:45
8/1/13 16:30
8/1/13 19:15
8/1/13 22:00
8/2/13 0:45
8/2/13 3:30
8/2/13 6:15
8/2/13 9:00
8/2/13 11:45
8/2/13 14:30
8/2/13 17:15
8/2/13 20:00
8/2/13 22:45


2012 Electric Consumption
2013 Electric Consumption
2012 CDD
2013 CDD
kWh
Degree Days
250,000
200,000
150,000
100,000
50,000
0
500
450
400
350
300
250
200
150
100
50
0
January
February
March
April
May
June
July
August
September
October
November
December


Percent Reduction, 2012 vs. 2013 Electric Consumption
December
November
October
September
August
Average Percent Reduction
28%
0.0%
5.0%
10.0%
15.0%
20.0%
25.0%
30.0%
35.0%
40.0%
45.0%
50.0%


2012 Steam Consumption
2013 Steam Consumption
2012 HDD
2013 HDD
MLbs
Degree Days
800
700
600
500
400
300
200
100
0
1000
900
800
700
600
500
400
300
200
100
0
January
February
March
April
May
June
July
August
September
October
November
December


Percent Reduction, 2012 vs. 2013 Steam Consumption
December
November
October
September
August
Average Percent Reduction
59%
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%

Savings Summary

- Annual Savings
  - $107,843 in Electric & Steam Savings
  - ~$70,000 Operations
  - Payback of less than 2 years!

ECM #	ECM Description	Engineering & Modifications	Energy Saved (kWh)	Steam Savings (Mlbs)	Annual Dollars Saved	Total Cost	Rebate	Simple Payback Period
1	Nighttime & Weekend Shutdown/ Setback	Change BMS Operating Schedule; inclusive of Waterside and Airside Economizer Optimization ECMs (3A, 3B, 5)	445,929	1,126	$79,097	$82,453	$0	1.0
2	Static Pressure Reset	Program AHU VFD reset schedule based on VAV box damper positions; inclusive of heat load analysis and rebalancing	208,299		$28,745	$100,520	$30,270	2.4
Total Savings & Costs			**654,228**	**1,126**	**$107,843**	**$182,973**	**$30,270**	**1.4**

Awards

- BCxA 2014 Cx Project Award
  - Existing Bldg Category

- Urban Green 2015 Ebie Finalist
  - “Smooth Operator”

Lessons Learned

- Clearly defined goals
- Commissioning Authority (CxA) leads the process
  - Objective & independent owner advocate
- Clearly defined written plan, roles, responsibility & scope
  - Input from Operations Team
  - Communicate and Coordinate with building staff & tenants
- Functional testing programs & requirements
- CxA provides input to resolve deficiencies
- Results documentation & reporting requirements
- Incorporate a Persistence Strategy at first meeting

This concludes The American Institute of Architects
Continuing Education Systems Course

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